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METHOD FOR FREQUENCY CORRECTION AND MODULATION OF AN OSCILLATION GENERATOR

Inventor:	Ing. (grad.) Klaus Junger 7151 Ailmersbach, DE
Applicant:	Licentia Patent-Verwaltungs-GmbH 6000 Frankfort, DE

Licentia Patent-Verwaltungs-GmbH

Theodor-Stern-Kai 1

D-6000 Frankfort 70

NE2-BK/Spe/jo

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Claims

1. Method for frequency correction and modulation of an oscillation generator, where in a regulation loop and using a phase discriminator, a reference signal is compared with an output signal of the oscillation generator, and the regulation voltage obtained at the phase discriminator is applied through a regulation voltage amplifier of a retuning capacitance diode connected in parallel to the oscillation circuit of the oscillation generator, characterized in that a constant direct current and a voltage derived from the regulation voltage, are applied to a second capacitance diode (2) which is parallel connected or series connected to the retuning capacitance diode (1), where the application of the regulation voltage amplifier must not be changed.

2. Method according to Claim 1, characterized in that the limit frequency of the regulation loop, which transfers the modulation applied to the reference signal, is kept constant.

3. Method according to Claim 1, characterized in that it makes possible a frequency modulation of the oscillation generator which is compensated to a reference signal by means of the regulation loop.

4. Circuit arrangement for carrying out the method according to Claims 1 and 2, characterized in that a compensation network (3) has the voltage which is derived from the regulation voltage applied to its first input (4), and the amplified regulation voltage is applied to its second input (5), in that the first input (4) is connected with the first terminal of a capacitor (6), and then the second terminal of this capacitor (6) is connected with one end of a resistance (7), whose other end is connected to the second input (5) and the first output (8) of the compensation network (3), in that the second terminal of the capacitor (6) is applied to the second output (9) and via a second resistance (10) to a constant voltage input (11), and in that the first output (8) is connected with the retuning capacitance diode (1) and the second output (9) is connected with a second capacitance diode (2).

5. Circuit arrangement for carrying out the method according to Claims 1 and 3, characterized in that a compensation network (3) has the modulation signal applied to its first input (4) and the amplified regulation voltage applied to its second input (5), in that the first input (4) is connected with the first terminal of a capacitor (6), in that the second terminal of this capacitor (6) is connected with one end of resistance (7), whose other end is connected with the second input (5) and the first output (8) of the compensation network (9), in that the second terminal of the capacitor (6) is connected with the second output (9) and via a second resistance (10) with a second constant voltage input (11), and in that the first output (8) is connected with the

retuning capacitance diode (1), and the second output (9) is connected with the second capacitance diode (2).

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Theodor-Stern-Kai 1

D-6000 Frankfort 70

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Method for Frequency Correction and Modulation of an Oscillation Generator

The invention relates to a method for frequency correction and modulation of an oscillation generator, where, in a regulation loop and by means of a phase discriminator, a reference signal is compared with an output signal of the oscillation generator and the regulation voltage obtained at the phase discriminator is applied via a regulation voltage amplifier of a retuning capacitance diode which is parallel to the oscillation circuit of the oscillation generator.

The oscillation generator with frequency correction and retuning capacitance diode is known from DE-PS 19 08 267. As a result of nonlinearities in the capacitance characteristic curve of the retuning capacitance diode, the loop amplification of the entire frequency correction device is changed. To compensate for these nonlinearities, in DE-PS 19 08 267, between the

phase discriminator and the oscillation generator, an amplifier is connected, whose negative feedback is adjusted in such a manner that the loop amplification of the frequency correction device remains largely constant independently of the set oscillation generator frequency of the oscillation generator. The negative feedback network is an additional device which is subject to breakdown. In the case of this circuit, the amplifier tends to produce oscillations. In addition, it is only possible to reach a low modulation frequency and a low limit frequency of the regulation loop.

The frequency regulation device and modulation of the oscillation generator at a single capacitance diode with constant sloop can only be achieved at great expenditure, without followup of the regulation voltage amplifier. The problem of the invention therefore is to provide a method of the above mentioned type in which, using inexpensive circuitry, a characterized circuit arrangement can be achieved, which, moreover, is less susceptible to disruptive voltages and which has a nearly constant slope up to high modulation frequencies.

This problem is solved by applying to a second capacitance diode, which is parallel or series connected to the retuning capacitance diode, and to which the modulation signal is applied, a constant direct current and a voltage derived from the regulation voltage, where the amplification of the regulation voltage amplifier must not be changed.

In Claims 2 and 3, special embodiments of the method according to the invention are characterized. Claims 4 and 5 indicate advantageous circuit arrangements for carrying out the method.

The advantages of the solution according to the invention result from the constancy of the slope over a very larger retuning range, the easy setting of the modulation slope through a bias voltage Ui, the prevention of a tendency to oscillations in the case of wobbling of the oscillation

generator (search mode), because the loop amplification of the regulation loop is kept constant. The solution according to the invention is particularly suitable for very high frequencies, for example in connection with cavity or coaxial resonators, because here a simple coupling of the capacitance diode is possible. In connection with the regulation loop, the constant loop amplification can be achieved without regulation or resetting of the regulation amplifier. Therefore, the amplifier can be more simple in construction, it can produce greater amplification and have a higher limit frequency, which in turn is expressed in a higher limit frequency of the regulation loop.

The invention is explained in greater detail below with reference to the drawings. In the drawings

Figure 1 shows the compensation network and the arrangement of the capacitance diodes,

Figure 2 shows the frequency dependence of the second capacitance diode,

Figure 3 the slope as a function of the bias voltages

Figure 4 shows an embodiment example with phase modulation,

Figure 5 shows the course of the amplification as a function of the frequency,

and

Figure 6 shows an embodiment example with frequency modulation.

In Figure 1, the frequency determining elements 1, 2, 12, 13, 14, 15 of the oscillation generator 16 are represented. At the input 5 of the compensation network 3, the bias voltage Un is applied to the retuning capacitance diode. At the input 11, a constant direct voltage Ui is applied.

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The latter is applied via a second resistance 10 to the modulation capacitance diode (second capacitance diode 2) and it overlaps with the bias voltage Un which is applied via the first resistance 7 to form the bias voltage Um. The modulation change voltage is applied via the capacitor 6. The signals at the outputs 8 and 9 of the composition network 3 are applied to the capacitance diodes 1 and 2, where, in each case, between the application points and the reference potential, capacitors 12 and 13 are inserted. These capacitors 12 and 13 represent the coupling of the capacitance diode 1 and 2 to the resonance circuit 14 and 15 of the oscillation generator.

The compensation network 3 has, in connection with the oscillation circuit of the oscillation generator and the two capacitance diodes, the following function:

If the oscillation circuit is modulated with the second capacitance diode 2, the circuit has the nonlinear frequency f represented in Figure 2 for the bias voltage Um. Figure 3 shows the slope Sm as a function of each bias voltage U, Um or Un. The slope Sm = df/dUm for the bias voltage Um is represented in Figure 3, Curve I. Curve I according to Figure 3 applies to the case where the capacitance 15 of the oscillation circuit is constant, and Un and thus the capacitance of the retuning capacity diode 1 are kept constant. If the bias voltage Um at the second capacitance diode 2, and thus also its capacity, is kept constant, and the bias voltage Un varies, the capacitance of the retuning capacitance diode 1 and thus the total capacity of the oscillation circuit changes. Thus, the ratio of capacitance change of the second capacitance diode 2 to the total capacitance of the oscillation circuit, without the influence of the capacity of the second capacitance diode 2, changes as a function of the bias voltage Un of the retuning capacitance diode 1. This means that, with increasing bias voltage Un, the slope Sm also increases. Figure 3, Curve II shows this dependence of Sm as a function of Un at constant bias voltage Um without compensation. By means of the compensation network 3, the bias voltage Um is slightly

entrained with the bias voltage Un, that is with increasing bias voltage Un, Sm increases, however, since Um now also increases, Sm decreases again. If the dimensions of the compensation circuit 3 are appropriately chosen, the slope Sm can be kept constant over a large retuning range. Figure 3, Curve III shows this slope Sm which is maintained constant, as a function of the bias voltage Un with compensated bias voltage Um.

Figure 4 shows an embodiment example of the invention with phase modulation. A portion of the output signal of the oscillation generator 16 is decoupled by means of the directional coupler 17 and applied to the phase discriminator 18, directly or after frequency conversion by means of an oscillation generator frequency fo in the mixer 23. The phase discriminator 18 compares this signal with a modulated input signal HF or ZF, which has an intermediate or a high frequency, and which is also applied to it. The regulation voltage obtained at the phase discriminator 18, is applied to the input of the regulation voltage amplifier 19. The regulation voltage amplifier 19 has two separate paths for amplification. On the one hand, the regulation voltage is applied, amplified, as bias voltage Un to the input 5 of the compensation network 3 and, on the other hand, via a separation capacitor, the direct voltage-free signal derived from the regulation voltage is applied, amplified, as modulation signal to the input 4 of the compensation network 3.

Figure 5 shows the qualitative course of the amplification V of the regulation voltage 19 as a function of the frequency f. The limit frequency of the regulation loop in this embodiment variant is approximately 60 MHz and it is constant. A distortion-free transmission is achieved up to more than 10 MHz at a frequency of the oscillation generator of 7 GHz.

Figure 6 shows an embodiment example of the invention with frequency modulation. A portion of the output signal of the oscillation generator 16 is decoupled by means of the

directional coupler 17 and applied to the phase discriminator 8 after frequency division in the divider 22 or with additional frequency conversion by means of an oscillation generator frequency fo in the mixer 23. The phase discriminator 18 compares this signal with a reference signal 20, which can be, for example, an unmodulated HF carrier. The regulation voltage obtained at phase discriminator 18 is applied to the regulation amplifier 19, which delivers, at its output, the bias voltage signal Un for the compensation network 3. The modulation signal 21 is applied to the compensation network 3 at the input 4. The limit frequency of the regulation loop during frequency modulation is lower than the lowest modulation frequency. The regulation loop is here used only for frequency correction.

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